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Seed priming techniques for drought tolerance and its effect on growth of hybrid castor

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ABSTRACT

A study was conducted to estimate the effect of seed priming techniques on germination and growth performance of castor. The seeds were subjected to priming in different concentration (1, 2 and 3 %) of solution *viz.*, $ZnSo_4$, Kcl, KH_2PO_4, $CaCl_2$,Cowdung slurry and water along with unprimed dry seed as a control. The result revealed that percentage of seed germination, germination index, speed of germination, seed vigour index, seedling shoot and root length, seedling root volume, seedling root and shoot dry weight and relative water content of castor were significantly higher with 2 per cent $ZnSo_4$ primed seed, Hydropriming with 2 per cent $ZnSo_4$ is the most promising priming technique for enhancing seedling characters and drought tolerance.

KEYWORDS: Castor, drought, seed priming, seedling characters

INTRODUCTION

Seed priming is a technique to help viability and germination of seeds, and in the same process there are option to induce stress tolerance and many traits in the plants [1]. Commonly seed priming is conducted with chemicals which are useful for the plant growth and productivity. The seed priming techniques and agents differ from plants to plants, but mostly there are some chemicals which are commonly used in seed priming techniques [2]. Ashraf and Foolad [3] reviewed various purposes of seed priming and reported that, the main purpose of this technology is that it will partially hydrate the seed to a point where germination triggers. Also, this is mainly important in desiccation stress tolerance studies and other abiotic stresses like salinity.

Castor (*Ricinus communis* L.) is an important plant producing seeds with non edible oil which can be utilized in industries and also for biofuel production [4]. The nonedible oils crops are also equally important, as they are important sources of feeds and in preparation of economically important products in cosmetic industry [5]. The production of castor crop in India is mainly in irrigated and rainfed manner, but the yield is relatively low. Under prevailing conditions, per hectare yield of the crop is very lower than that of potential of different varieties under cultivations.

Fast and uniform germination is fundamental to accomplish higher yield with great quality [6]. Oil seeds are especially susceptible for environmental stresses. The oil will oxidize, and in turn reduce the health of the seeds in dry environments [7]. Seed preparing is a most useful technique to encourage fast and uniform germinations and development of seeds and to expand the seed to stresses [8]. Keeping these in view, the present investigation was formulated to find out suitable methods of seed priming on its seedling health and drought tolerance of castor.

MATERIALS AND METHODS

Field experiments were conducted at Annamalai University experimental farm, Department of Agronomy. Annamalai University, Annamalai Nagar, Tamil Nadu to find out the effect of seed Priming on the seedling health and drought tolerance of hybrid castor. The field experiment was carried out in a Randomized block design with three replications. The cultivar under the study was hybrid castor GCH4.The experiment site is geographically located at 11° 24' N Latitude and 79° 44'E Longitude and at an Altitude of +5.79 m above mean sea levels. The soil was a clay in texture with EC of 0.4 dsm^{-1} and the pH of 7.5. Priming treatments were imposed with water, cow dung solution of $ZnSo_4$, Kcl, KH_2PO_4 and $CaCl_2$. Each salt solutions were prepared in three different concentrations viz., 1, 2 and 3 per cent and the seed were soaked in double the volume of solutions for 12 hours. Seeds were fully immersed in priming media at a temperature of 24°C for 12 hours [9]. Thereafter, the seed was washed with tap water [10]. The treated seed was dried back to its original moisture content at

room temperature. Dried seed was used as control. Primed seed were hand dibbled @ 2 seeds hill^{-1} in poly bag of 10 x 10 cm size filled with red soil, sand and FYM (2:1:1 ratio). Data on speed of germination [11], seed vigour index [12] seedling shoot and root length, root volume and seedling dry weight and relative water content were recorded. The data obtained from various treatments were analyzed by F-test of significance following the methods described by Gomez and Gomez [13].

RESULTS AND DISCUSSION

Seed Germination Character

Priming the seed with 2 per cent $ZnSo_4$ (T_5) was significantly superior (Table 1.) in registering higher germination of 99.66 per cent, germination index of 4.00 and seed germination speed of 16.65. The next in merit was priming the seed with 3 per cent Kcl (T_9) and 3 per cent Cowdung slurry (T_3). The lower germination of 85 per cent, germination index of 3.2 at 10 DAS and germination speed of 8.4 were noticed with unprimed seeds (T_1). The higher seed germination characters are due to primed seeds under moisture stress condition. Moreover, during priming the metabolic energy in primed seed is greater than in adenosine diphosphate. The present investigation is in line with the earlier reports [14,15].

Seedling Characters

Among the different treatments tested, priming the seed with 2 per cent $ZnSo_4$ (T_5) was significantly superior over other treatments by registering the higher seedling vigour index of 30.30, seedling root length of 24.3 cm, seedling shoot length of 32.8 cm, seedling root volume of 3.00 cc seedling$^{-1.}$ and seedling shoot dry weight of 0.82 g seedling^{-1}(Table 2.). The lowest seedling vigour index of 16.20, root length of 7.0 cm, shoot length of 18.0 cm, seedling root volume of 1.7 cc seedling^{-1} and seedling shoot dry weight of 0.28 g seedling^{-1} were noticed with unprimed seeds (T_1). The probable reason for early and higher germination of seeds primed may be the completion of pre-germinative metabolic activities in comparison with the unprimed control. Emergence enhancement may be attributed to metabolic repair process, a buildup of germination metabolities during seed priming [16].

Table 1: Effect of seed priming on the germination percentage, germination index, speed of germination and seedling vigour index of hybrid castor

Treatments	Germination percentage (%)	Germination index	Speed of germination	Seedling vigour index
T_1- Control	85.33	3.20	8.54	16.20
T_2-Water soaking	90.66	3.60	10.06	17.43
T_3-Cowdung slurry	95.66	3.80	11.04	27.55
T_4-1% $ZnSo_4$	95.66	3.80	11.10	22.33
T_5-2% $ZnSo_4$	99.66	4.00	16.65	30.30
T_6-3% $ZnSo_4$	95.33	3.80	15.77	24.32
T_7-1% Kcl	90.33	3.60	12.66	24.30
T_8-2% Kcl	82.66	3.30	10.82	18.56
T_9-3% Kcl	97.66	3.90	11.22	27.59
T_{10}-1%KH_2PO_4	95.33	3.80	11.34	23.28
T_{11}-2% KH_2PO_4	92.36	3.70	10.95	24.51
T_{12}-3% KH_2PO_4	85.33	3.40	9.18	22.53
T_{13}-1% $CaCl_2$	97.66	3.90	12.32	20.48
T_{14}-2% $CaCl_2$	85.33	3.40	11.03	24.82
T_{15}-3% $CaCl_2$	92.36	3.70	10.85	27.29
$S.E_D$	--	0.0005	0.43	1.22
C.D (p=0.05)	NA	0.01	0.82	2.43

Table 2: Effect of seed priming on the seedling characters of hybrid castor

Treatments	Seedling root length (cm)	Seedling shoot length (cm)	Seedling root volume (cc)	Seedling shoot dry weight (g)
T_1- Control	7.00	18.00	1.7	0.28
T_2-Water soaking	10.50	20.51	2.4	0.32
T_3-Cowdung slurry	14.42	28.00	2.8	0.62
T_4-1% $ZnSo_4$	17.51	23.52	2.0	0.50
T_5-2% $ZnSo_4$	24.31	32.81	3.0	0.82
T_6-3% $ZnSo_4$	21.50	25.60	2.6	0.53
T_7-1% Kcl	13.51	27.00	2.0	0.38
T_8-2% Kcl	15.51	22.51	2.2	0.40
T_9-3% Kcl	19.51	29.82	2.2	0.78
T_{10}-1%KH_2PO_4	20.01	24.52	2.5	0.57
T_{11}-2% KH_2PO_4	10.01	26.51	2.2	0.61
T_{12}-3% KH_2PO_4	11.51	29.5	2.7	0.78
T_{13}-1% $CaCl_2$	16.51	21.00	2.8	0.72
T_{14}-2% $CaCl_2$	14.51	29.22	2.2	0.64
T_{15}-3% $CaCl_2$	9.531	26.5	2.4	0.60
$S.E_D$	0.93	0.3	0.05	0.01
C.D (p=0.05)	1.86	0.6	0.1	0.02

Table 3: Effect of seed priming on the turgid leaf weight, dry weight and relative water content of hybrid castor

Treatments	Turgid leaf weight (g)	Dry leaf weight (g)	Relative water content
T_1- Control	3.64	0.51	65.18
T_2-Water soaking	3.36	0.36	63.00
T_3-Cowdung slurry	7.61	0.54	41.30
T_4-1% $ZnSo_4$	5.54	0.56	50.00
T_5-2% $ZnSo_4$	8.72	0.58	37.10
T_6-3% $ZnSo_4$	4.46	0.53	44.78
T_7-1% Kcl	5.52	0.51	50.30
T_8-2% Kcl	4.26	0.39	54.01
T_9-3% Kcl	4.37	0.46	53.45
T_{10}-1%KH_2PO_4	3.49	0.42	56.03
T_{11}-2% KH_2PO_4	5.27	0.46	58.84
T_{12}-3% KH_2PO_4	5.35	0.56	56.16
T_{13}-1% $CaCl_2$	5.53	0.52	47.70
T_{14}-2% $CaCl_2$	5.35	0.51	55.58
T_{15}-3% $CaCl_2$	5.07	0.54	47.68
$S.E_D$	0.48	0.006	1.91
C.D (p=0.05)	0.98	0.01	3.82

Relative Water Content

Among the seed priming technique, priming the hybrid castor seed significantly recorded the less relative water content 37.10 than other treatments (Table 3.). The highiest relative water content of 65.18 was noticed with unprimed seeds. This indicating the $ZnSo_4$ primed seed at 2 per cent have the ability of young seedlings to absorb more water and nutrient from the soil and ultimately lead to produce quality and health seedlings [17].

CONCLUSION

Based on the result of present investigation, it can be concluded that priming the hybrid castor seed with 2 per cent $ZnSo_4$ favourably enhanced the seedling quality. In general, on-farm seed priming of rainfed castor cultivars with $ZnSo_4$ can accelerate emergence speed and percentage of seed germination and improving the ability of seedling to with stand drought at the lowest possible cost.

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